

CONFIDENTIAL

9 NOV 64

Post Office Box 6788
Fort Davis Station
Washington, D.C. 20020

25X1A REGISTERED



25X1A Attention: Mr.

Subject : Proposed Contract for
Sine-Wave Testing Equipment

Per 4074

Gentlemen:

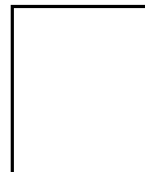
25X1A

In accordance with the recent conversations between your corporation and representatives of this organization it is proposed that performance incentives be applied to the subject contract as follows:

I. Resolution

Spatial frequency capability of the instrument will be evaluated on three levels of performance:

- a. 228 1/mm (minimum acceptable)
- b. 600 1/mm (Target Goal)
- c. 1040 1/mm (Incentive Goal)



25X1A

Test targets over 228 1/mm will be supplied as Government Furnished Equipment.

II. Accuracy of MTF Measurement

The accuracy and precision of the equipment shall be demonstrated by the following procedure:

25X1A

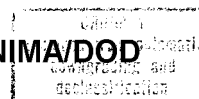
25X1A

A microscope objective of high quality is to be placed in a finite fixture having an adjustable aperture stop. This stop shall be circular and shall be adjusted to allow the lens to operate in a diffraction-limited mode. The diffraction limit shall be a lower frequency than the highest frequency on the testing target. The fixture shall also permit longitudinal focal shifts of 0, 1/4, 1/2, 3/4 and 1 wave of defocusing.

NOTICE

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Sec. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

Declass. Review by NIMA/DOD



CONFIDENTIAL

15015
25X1A

Technical Notes on the Use of the [REDACTED]
Sine Wave Test System

25X1A

[REDACTED] sine wave test system for measuring modulation transfer functions consists of the following units:

- a. Variable modulation test target box with integral, but adjustable, 15 bar resolution target. Adjacent 15 bar patterns on the resolution target have a spatial frequency ratio of $\sqrt[10]{10} = 1.259$.
- b. Power supply for the illuminating lamp in the variable visibility target box.
- c. A zoom microscope. This microscope is equipped with a special eyepiece assembly, sinusoidal filters, 10x, 20x and 40x Wild objectives, and 10x and 20x eyepieces.

The variable modulation optical test target box displays a series of 15 bar patterns such that their modulation (visibility) can be varied continuously between 0 and 96%. The line frequencies provided vary from 1 1/mm to 1000 1/mm. The frequency ratio of two consecutive 15 bar patterns is $\sqrt[10]{10} = 1.259$. A complete table of line frequencies present in the target is attached. The modulation

of the target can be changed by the observer by rotation of the wheel having the angular divisions. The divisions on this wheel are 2° apart, and the scale is numbered from 0 to 360. From these readings, (φ), the visibility of the target can be calculated using the formula

$$V = 1.01 \sin^2 \frac{\varphi}{4} - 0.049 \sin^4 \frac{\varphi}{4}.$$

A table of φ against V is attached.

The resolution target is mounted in a slide which can be pulled out from the side of the instrument. It is possible to position the target in the slide in eight different ways in steps of 45° .

The zoom microscope is provided with a specially designed eyepiece which accepts sinusoidally modulated filters with various contrasts and frequencies.

Three sinusoidally modulated filters have been provided with the instrument:

15 1/mm	$V_F = 0.127$
10 1/mm	$V_F = 0.166$
5 1/mm	$V_F = 0.243$

-3-

Knurled rings are provided to adjust the targets angularly and laterally. The entire eyepiece can be rotated in steps of 45° by means of click stops.

To Measure M.T.F.:

To use the instrument the variable modulation optical test target box is placed in the object plane of the lens system under test, or in the focal plane of a collimator. The image is observed with the zoom microscope. After choosing a target pattern, the appropriate sinusoidal filter is inserted in the eyepiece, and the magnification of the microscope is adjusted till the image of the pattern in the filter plane coincides in frequency with the filter. The filter is moved laterally and the target visibility is adjusted till the modulation of the pattern image, as observed through the filter, is reduced to zero. If V_T is the pattern modulation calculated from the angle-reading (φ) after this adjustment, and V_F is the modulation of the filter, the transfer function of the optical system for the selected frequency follows from

$$\tau = \frac{V_F}{V_T}$$

Lamp and Replacement Procedure

- a. The Lamp. Sylvania #6.6A/T2-1/2Q/CL-45W.
- b. Replacement.
 - 1. Allow the lamp house to cool.
 - 2. Remove lamp end cap adjacent to lamp house latch release button by removing three black Allen cap screws.
 - 3. Withdraw old lamp.
 - 4. Pass new lamp through lamp house and interior tubes and insert in socket on far side.
 - 5. Rotate lamp in socket until protuberance on the lamp center section is pointing upwards at 45° to the rear.
 - 6. Replace end cap and screws being careful to insure that the contact within the end cap is engaged in the recess in the end of the lamp.

-5-

V	φ	4φ
0.0	00.00	00.0
.010	5.70	22.8
.020	8.08	32.4
.030	9.92	39.7
.040	11.48	49.9
.050	12.86	51.5
.060	14.11	56.5
.070	15.27	61.1
.080	16.36	65.5
.090	17.39	69.6
.10	18.37	73.5
.11	19.30	77.2
.12	20.20	80.8
.13	21.07	84.3
.14	21.92	87.7
.15	22.73	91.0
.16	23.53	94.2
.17	24.31	97.3
.18	25.07	100.3
.19	25.81	103.3
.20	26.54	106.2
.21	27.26	109.1
.22	27.96	111.9
.23	28.66	114.7
.24	29.34	117.4
.25	30.02	120.1
.26	30.69	122.8
.27	31.34	125.4
.28	32.00	128.0
.29	32.64	130.6
.30	33.28	133.2
.31	33.92	135.7
.32	34.55	138.2
.33	35.17	140.7
.34	35.79	143.2
.35	36.41	145.7
.36	37.02	148.1
.37	37.36	150.6
.38	38.24	153.0
.39	38.84	155.4
.40	39.45	157.8
.41	40.05	160.2
.42	40.65	162.6
.43	41.25	165.0
.44	41.84	167.4
.45	42.44	169.8
.46	43.04	172.2
.47	43.63	174.6

-6-

.48	44.23	176.90
.49	44.82	179.30
.50	45.42	181.70
.51	46.02	184.10
.52	46.62	186.50
.53	47.22	188.90
.54	47.82	191.30
.55	48.42	193.70
.56	49.03	196.10
.57	49.63	198.60
.58	50.24	201.00
.59	50.86	203.50
.60	51.47	205.90
.61	52.10	208.40
.62	52.72	210.90
.63	53.35	213.40
.64	53.98	216.00
.65	54.62	218.50
.66	55.27	221.10
.67	55.92	223.70
.68	56.58	226.30
.69	57.24	229.00
.70	57.91	231.70
.71	58.60	234.40
.72	59.29	237.20
.73	59.99	240.00
.74	60.70	242.80
.75	61.42	245.70
.76	62.16	248.70
.77	62.90	251.60
.78	63.67	254.702
.79	64.45	257.80
.80	65.25	260.98
.81	66.07	264.26
.82	66.91	267.63
.83	67.78	271.11
.84	68.68	274.69
.85	69.61	278.41
.86	70.57	282.27
.87	71.58	286.31
.88	72.64	290.56
.89	73.76	295.04
.90	74.96	299.83
.91	76.25	305.00
.92	77.67	310.66
.93	79.26	317.02
.94	81.11	324.45
.95	83.46	333.84
.96	87.40	349.60



22-863/22-864 HIGH RESOLUTION TEST TARGETS

This target contains three groups of fifteen-bar high contrast targets. The spatial frequency ratio between successive targets is $10\sqrt{10}$. The target of highest spatial frequency in each group is repeated as the target of lowest spatial frequency in the next group, making a total of 31 distinct target frequencies. The maximum variation in width between light and dark bars is less than 5 per cent over the 1 to 300 cycles/mm range. The density difference is greater than 2.0. The spatial frequencies in each group in cycles per millimeter are as follows:

<u>GROUP I</u>	<u>GROUP II</u>	<u>GROUP III</u>
1.00	10.00	100.0
1.26	12.59	125.9
1.58	15.85	158.5
2.00	19.96	199.6
2.51	25.12	251.2
3.16	31.63	316.3
3.98	39.82	398.2
5.01	50.14	501.4
6.31	63.13	631.3
7.95	79.48	794.8
10.00	100.00	1000.0

CONFIDENTIAL

The sine-wave testing equipment shall be used to measure the transfer function of the lens under these conditions of focal shift. Measurements shall be made for at least two different aperture stops. Comparison of measured and calculated transfer curves shall fall within:

25X1A

It is requested that your concurrence in this statement of performance incentives be confirmed in writing to this office.

Very truly yours,

25X1A

Contracting Officer

Distribution:

- Original - Addressee
- 1 - Proposed Jacket File
- 1 - NPIC Budget
- ✓ 2 - NPIC
- 1 - Extra

25X1A

25X1 OL/PD/CB/R&DC (9 Nov 64)

CONFIDENTIAL

25X1A

X

25X1A

NPIC 2623

25X1

☐ CONFIDENTIAL Agency Sterile
Contingent upon availability of FY-65 Funds

25X1A

6 July 1964
18/6/64 5500-8506-65

5155-4100

5155-4100

1.

Sine Wave Testing equipment
portable in accordance with
proposal dated 27 March 1964.

1

25X1A

Proposal Recently Forwarded to
OL/ES.

25X1A

Copy of Approval signed by

dated 1 July '64 attached.